

REMARKS

Claims 1, 2, 5, and 9 have each been amended. The amendments to claim 1 respond to the §112 rejection of claim 1 by adding the term "aluminosilicide" after "molybdenum" and deleting "Mo(Si_{1-y}Al_y)₂." That addition is based upon paragraph [0017] of the substitute specification. Further, the word "mixture" has been added to claim 1 in the mixing step, the word "formed" has been added at four places in the sintering step, and the last clause of the sintering step has been amended for clarification. As above amended, claim 1 is believed to be in definite form. Accordingly, each of the dependent claims is also in conformity with §112 by virtue of their dependence from amended claim 1.

The amendment to claim 2 is for clarification, and the amendments to claims 5 and 9 correspond with the material designation included in the amendment to claim 1.

Claims 6, 8, and 9 were rejected as anticipated by the Schrewelius '145 reference, and alternatively as obvious based upon the Schrewelius '145 reference. In considering claim 6, which incorporates the method steps claimed in claim 1 and from which claims 8 and 9 directly depend, the examiner considered that claim as a product by process claim and concluded that "it appears that the product in Schrewelius '145 would be the same or similar as that claimed; especially since both applicant's product and the prior art product is made of a powdered molybdenum-silicide." But the applicant's product and the prior art product are not the same.

With regard to the Schrewelius '145 reference, it should at first be noted that

that reference is directed to a thermocouple alloy, not to an electrical heating element. It is also important to note that the Schrewelius '145 reference teaches the use of bentonite as the ceramic binding substance for the composition for each of the legs of the thermocouple that is the subject of that reference (see Schrewelius '145, col. 3, line 3 for the teaching of bentonite as a component of the positive leg of the thermocouple and line 15 for the teaching of bentonite as a component negative leg of the thermocouple). Thus, in addition to the Schrewelius '145 reference failing to disclose molybdenum aluminum silicide mixed in combination with SiO₂ having at least 98% purity, as specifically recited in claim 1, it also teaches the use of bentonite, which claim 1 excludes from the composition produced by the claimed method, as well as from the claimed electrical heating element of claim 6. Thus, the Schrewelius '145 reference teaches away from the invention as it is claimed in each of claims 1 and 6, as well as in the other dependent claims.

And it is noteworthy that in the first paragraph on page 7 of the Action the examiner specifically admitted that the Schrewelius '145 reference does not disclose:

...the product being formed by the method also consisting essentially of (i.e. comprising) Al₂O₃; and the SiO₂ being at least 98% pure and the heating element being free of bentonite; and the oxide layer not peeling under thermal cycling at about 1500°C, whereby heating oven contamination in the form of peeled heating element oxide layer particles in a heating oven containing the heating element *is prevented*. (emphasis in original)

By virtue of that unambiguous admission by the examiner, claims 6, 8, and 9 are clearly not anticipated by the Schrewelius '145 reference, and they also are not obvious thereover because of the several significant admitted differences between

the invention as claimed in those claims and the disclosure contained in the Schrewelius '145 reference.

Claims 1, 4 through 6, 8, and 9 were rejected as obvious based upon a combination of the Schrewelius '145 and '959 references, together with the Sekhar et al. '399 reference. The primary Schrewelius '145 reference was discussed above in connection with the anticipation and obviousness rejections of claims 6, 8, and 9, and those same distinctions apply to claim 1, from which claims 4 and 5 depend.

With regard to the Schrewelius '959 reference, the second paragraph on page 7 of Action contains several statements concerning that reference that are not supported by the text of that reference. First of all, it was said in the Action that the Schrewelius '959 reference "teaches a method of producing a molybdenum-silicide-type heating element in which a Al_2O_3 product is formed via the chemical reaction to form a ceramic glass component that efficiently stops the grain growth of the silicide at high temperatures (column 5, lines 69-75; column 6, lines 1-7)." But the exterior surface is "a film of silica glass" (col. 5, line 45) that is "a reaction product substantially of Al_2O_3 and SiO_2 formed during the oxidation (col. 6, lines 3-5). Thus, instead of an oxide layer consisting essentially of Al_2O_3 as claimed in claim 1, the outer layer of the heating element of the Schrewelius '959 reference is a film of silica glass, which is mainly aluminum silicate (col. 5, lines 66-67). And if the Al_2O_3 is a constituent that undergoes reaction with SiO_2 , as taught by the Schrewelius '959 reference, it is no longer present as Al_2O_3 because the outer layer is "mainly aluminum silicate," also as taught by that reference.

Secondly, regarding the matter of peeling of the oxide layer under thermal

cycling, which the claimed invention overcomes, the Schrewelius '959 reference only refers to a constant temperature (col. 7, lines 46-49), and not to thermal cycling. Therefore, the different, silica glass coating taught by that reference was not disclosed as having been subjected to thermal cycling, and it cannot be concluded that it would not peel if subjected to that condition.

Thirdly, it was implied at lines 6-7 on page 8 of the Action that there was not "a clear indication in the specification or claims of what the basic and novel characteristics actually are." But the substitute specification identifies the novel characteristics as solving the problem of peeling oxide coatings under cyclic operation (see paragraphs [0014] to [0016], [0024], and [0027]), and identifies the characteristics to achieve that solution in paragraph [0017] and in the paragraphs under the heading "Description of the Preferred Embodiments." Consequently, the term "consisting essentially of" cannot be construed as equivalent to "comprising" and is more restrictive by occupying a middle ground between closed claims and fully open claims.

The Sekhar et al. reference was relied upon for disclosing the use of pure SiO_2 . However, the disclosure of the use of pure SiO_2 to raise the working temperature range of a heating element says nothing about thermal cycling or about peeling of a surface layer. All the temperature tests disclosed in that reference appear to have been run under steady state conditions. Further, in the paragraph bridging pages 9 and 10 of the Action mentioning the Schrewelius '145 reference, reference was made to the operating temperature disclosed in that reference, but, again, that reference also says nothing about thermal cycling or about peeling of a

surface layer. And concerning the mention in that same paragraph of Sekhar et al. using pure SiO_2 instead of bentonite in Example 12, that example is based upon composition AA, which is identified at col. 7, line 66 to col. 8, line 8, and which does not identify an outer layer of Al_2O_3 , and thus it cannot relate to peeling of such an outer layer, or to thermal cycling of a heating element having such an outer layer.

On page 9 of the Action, at the middle of the first full paragraph, it is concluded that it would have been obvious to modify the Schrewelius references by replacing bentonite with the pure SiO_2 disclosed by the Sekhar et al. reference. But in Process II at column 10 of the Sekhar et al. reference, in which bentonite is mentioned, and in Example 1 at column 13 the material is composition U, which includes bentonite, and which is processed in accordance with Process II. Moreover, Example 1 was a steady state test that was run at 1600°C for 40 hours, and it did not disclose or suggest thermal cycling operation, which would not have produced peeling of an outer layer of the heating elements. Thus, the person of ordinary skill in the art would be led by that combination of references to utilize bentonite, which is also the material of the Schrewelius references, and not the pure SiO_2 . And none of those references discloses or suggests the effects of thermal cycling of heating elements. Because they each fail to appreciate the problem, they cannot be said to teach or suggest a solution to such an unappreciated problem.

Claims 2 and 10 were rejected as obvious based upon the Schrewelius '145 and '959 references, together with the Sekhar et al. '399 reference, and in view of the Chyung et al. '091 reference. The Chyung et al. '091 reference was cited merely for a disclosure of mullite. However, the Chyung et al. '091 reference also

lacks those features recited in amended claim 1 that are noted in the discussion above relative to the other references that were relied upon. Accordingly, the addition of that reference to the combination asserted in connection with claim 1 still does not teach or even suggest the invention as it is claimed in amended claim 1, from which each of claims 2 and 10 depend. Again, however, there are no disclosures in any of the references relied upon that would lead one having only ordinary skill in the art to combine them in any way at all, let alone to arrive at the claimed invention. And it is not apparent from the references just which parts of which reference should be combined with which parts of the other references and which parts of the references should be ignored or discarded. Indeed, it appears that the only motivation for even selecting the references and then combining them in a particular way is the present disclosure. But it is improper to use as a road map or a template an inventor's disclosure in order to use against him that which only he has disclosed.

Claim 11 was rejected as obvious based upon the combination of the Schrewelius '145 and '959 references, together with the Sekhar et al. '399 and the Chyung et al. '091 references, in view of the Sawamura et al. '215 reference. The Sawamura et al. '215 reference was cited for disclosing sillimanite. But that reference also lacks the teaching or suggestion of the factors discussed above in connection with the other references and that are recited in amended claim 1. Therefore, even if the Sawamura et al. '215 reference were to be combined with the other references that are relied upon by the examiner, that combination still

does not teach or suggest the invention as claimed in claim 1, from which claim 11 indirectly depends.

In addition to the differences in materials and in the differences in the problems to which the individual references are directed, there are no disclosures in any of the references relied upon that would motivate one having only ordinary skill in the art to combine them in any way at all, let alone to arrive at the claimed invention. Because the problem addressed by the present invention is not mentioned in the references and is different from the problems to which the references are addressed, one of only ordinary skill in the art would not be led to those references for a solution to the problem of the peeling of an Al_2O_3 outer surface layer of a heating element that is subjected to thermal cycling between room temperature and 1500°C.

Additionally, even if one of only ordinary skill in the art were to consider the references relied upon, is not apparent from the references just which parts of which reference should be combined with which parts of the other references and which parts of the references should be ignored or discarded. Indeed, it appears that the only motivation for even selecting the references, and then combining them in a particular way is the present disclosure. But it is improper to use as a road map or a template an inventor's disclosure in order to use against him that which only he has disclosed.

Claim 1 clearly recites an Al_2O_3 surface layer that does not peel under thermal cycling between room temperature and about 1500°C. None of the references relied upon discloses or suggests an Al_2O_3 surface layer, nor do any of

the references even mention or appreciate the peeling problem to which the present invention is directed. In fact, the Sekhar et al. reference teaches away from the invention as it is claimed in amended claim 1. Thus, whether the references are considered alone or together, neither the individual references nor any attempted combination of them teaches or suggests the invention as it is claimed in amended claim 1, from which each of the other claims in the application depends, either directly or indirectly.

Finally, attached hereto is the Declaration Under 37 CFR 1.132 of coinventor Mats Sundberg. The Declaration provides the results of testing that was conducted on molybdenum silicide heating elements that were thermally cycled between room temperature and temperatures of from 1400°C to 1565°C. Compositions including different constituents containing SiO₂ were formed, tested, and evaluated from the standpoint of adhesion to the resulting heating elements of outer layers of Al₂O₃. In the examples described in paragraphs 3 and 7 the SiO₂ was provided in the form of bentonite, having 60% SiO₂, and in the examples described in paragraphs 4, 5, and 6 the SiO₂ was provided as a powder containing at least 98% SiO₂. In each of the tests in which the tested heating elements were prepared using bentonite as the source of SiO₂ (paragraphs 3 and 7) and thermally cycled, the resulting Al₂O₃ outer layer flaked and exhibited spalling (paragraph 3), or was fragile and porous (paragraph 7). But in the tests involving heating elements prepared using SiO₂ powder containing 98% SiO₂, after thermal cycling the resulting heating elements included Al₂O₃ outer layers that in each case adhered to the heating material surfaces and did not flake off (paragraphs 4, 5, and 6). The results of those tests

show that the adhesion to the heating element surfaces of heating elements prepared using 98% pure SiO₂ when subjected to thermal cycling between high temperatures of the order of about 1560°C and room temperature were clearly superior to those prepared using bentonite as the source of SiO₂.

Based upon the foregoing amendments and remarks, the claims as they now stand in the application are believed clearly to be in allowable form in that they patentably distinguish over the disclosures contained in the references that were cited and relied upon by the examiner, whether those references be considered alone or together. Consequently, this application is believed now to be in condition for allowance, and reconsideration and reexamination of the application is respectfully requested with a view toward the issuance of a Notice of Allowance.

The courtesy of an interview is requested if this amendment is not deemed to place the present application in condition for allowance. And in that event, the examiner is invited to telephone the undersigned to arrange a convenient time for such an interview.

Respectfully submitted,



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Alfred J. Mangels
Reg. No. 22,605
4729 Cornell Road
Cincinnati, Ohio 45241
Tel.: (513) 469-0470